

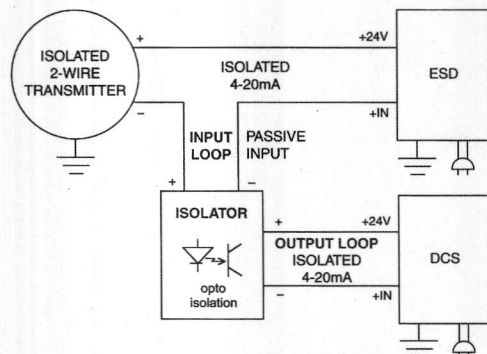
# Signal Isolators, Converters and Interfaces: The "Ins" and "Outs"

## Part Three of Four

### Beyond the Basics

#### Area Isolation (Divert and Protect Signals)

It is quite commonplace to share process signals between two different systems. It could be two control systems, one Emergency Shutdown System (ESD) and one control system, one DCS and a data acquisition system, and other numerous combinations. Generally it is unacceptable to create one series loop between the transmitter and two systems. Why? You would not want a series loop if you had to disconnect the input at one system for maintenance purposes, because both systems would lose the signal. One solution to sharing a variable with two systems is to use a single signal isolator (Figure 11). One system is declared the primary



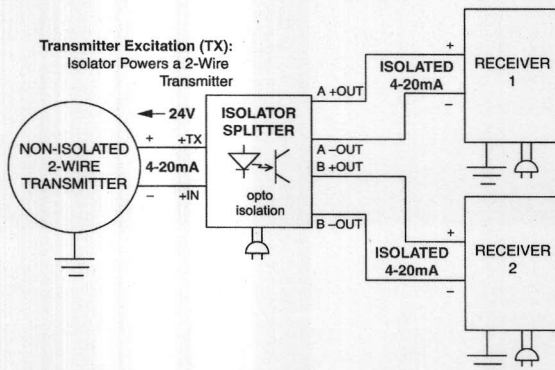
**Figure 11.** A signal isolator can be used to share a process variable with two different systems.

system, and it powers the transmitter. In Figure 11, the primary system is an ESD. The output loop-powered isolator (with a Passive Input) isolates the primary loop from the secondary loop. The DCS is the secondary loop. Maintenance can disconnect the input to the DCS without impacting the signal going to the ESD.

This architecture is very common, but there is a weakness to this design: if you had to disconnect the input to the ESD, then the DCS also loses the signal. Disconnecting the ESD input removes power from the transmitter. Fortunately, there is an alternative solution using a "Splitter."

#### Split a Signal

A signal splitter is a 4-wire signal isolator/converter that takes one signal input and provides two or more identical outputs proportional to the input. All inputs and outputs, and power, are isolated from one another. In Figure 12, the transmitter is provided a 24V power supply, called "Transmitter Excitation" (TX), by the splitter. The advantage of the splitter (versus Area Isolation) approach is that you can disconnect either control system for maintenance without affecting the signal going to the other system. Some of the popular splitter applications (other than area isolation) include custody transfer and isolating validated systems from non-

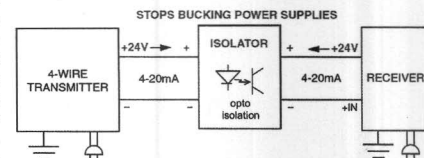


**Figure 12.** A signal splitter takes one signal input and provides two or more identical outputs proportional to the input.

validated systems in the bio-pharmaceutical market.

#### What is a Passive Input?

A common question is, "What happens to my input loop if I lose power to my isolator?" The good news is that nothing will happen to the input loop, assuming the isolator is not powering the input transmitter. An instrument with a Passive In-



**Figure 13.** A output loop-powered signal isolator put resembles a eliminates "Bucking Power Supplies."

put resembles a resistive load that is typically 20 or 50 ohms. This concern commonly arises when output loop-powered isolators/converters are used in conjunction with a critical input loop (Figure 11), such as a loop going to an Emergency Shutdown Device (ESD).

#### Solve "Bucking Power Supplies"

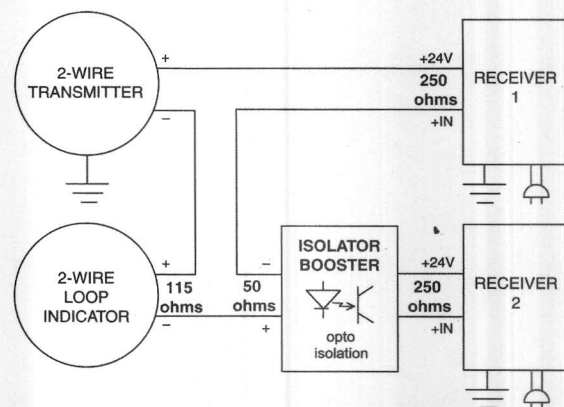
Some DCS manufacturers offer lower cost 4-20mA input cards. However, there is a significant tradeoff—the card must power all the loops. This is not a problem when all inputs are from loop-powered transmitters. But if you have 4-wire magmeters, or other line/mains-powered transmitters, both sides of the loop are trying to source the 4-20mA. The result is either too little current or no current at all. A simple output loop-powered isolator solves this problem. It can operate with powered inputs from both sides, thus restoring normal operations to the loop (Figure 13).

#### Provide Power to a 2-Wire Transmitter

Transmitter Excitation—It is often convenient, and cost-effective, to power a 2-wire transmitter from a 4-wire signal isolator/converter installed on the loop (Figure 12). Called "Transmitter Excitation" (TX), the isolator/converter provides 24V power supply which eliminates the need to install an additional instrument power supply.

#### Compliance Voltage

The term "compliance voltage" describes the internal voltage source driving the output current of a signal isolator/converter. Compliance voltage is related



**Figure 14.** A signal isolator adds more power, or drive capability, to an overburdened loop.

to drive capacity (in ohms) through Ohm's Law. Isolator outputs are often expressed in terms of drive capacity; like "4-20mA into 1000 ohms." To determine the compliance voltage from this specification, use the equation:  $V = 20mA \times 1000\text{ ohms} = 20V$ .

#### Boost a Signal

Loops rarely start out overburdened, but over time, devices get added to the point where the drive capacity of the transmitter is exceeded. Nominally, a 2-wire (loop-powered) transmitter, powered with 24V, will drive into 600 ohms. If your receiving device is still using a 250 ohm input impedance, it does not take much

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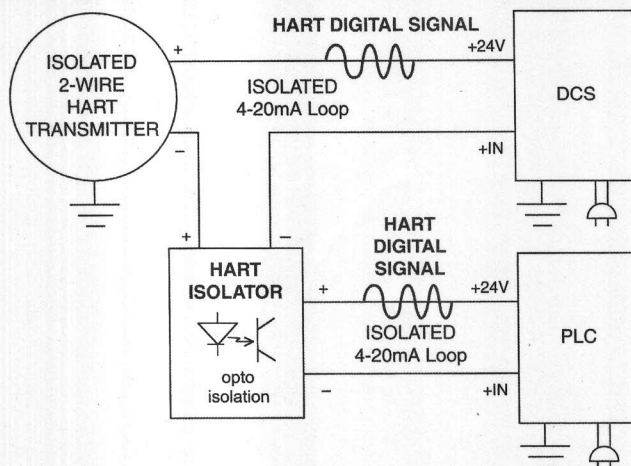
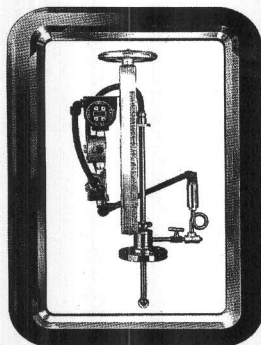


Figure 15. A HART isolator allows the HART digital signal to pass through the isolator.

to overburden the loop. A signal isolator solves the problem by providing a way to add more power—called drive capability—to an overburdened loop. In Figure 14, if you exclude the isolator from the loop there is an overall impedance of 615 ohms, plus wire impedance. That exceeds the 600 ohms drive of a loop-powered transmitter. With the isolator added to the loop, the input loop is satisfied with only 415 ohms plus wire. The output loop is also satisfied with only 250 ohms of load. The PLC's 24V powers the isolator, which in turn provides another 600 ohms of load capacity.

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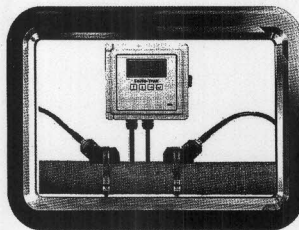
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### Pass or Block a HART Signal

By choosing the proper isolator, you can allow the HART signal to "pass" to the output side of the isolator and on to the receiving device. Alternatively, you can block the HART signal from going beyond the primary loop to the receiving device.

### Passing the HART Signal

Select a signal isolator that allows the HART signal to pass when you want a technician to be able to access a transmitter's process and diagnostic information via the HART signal, using a HART handheld, from any termination point on the loop (Figure 15). To pass the HART signal you need an isolator specifically designed for that purpose. A "hole" has to be created in the filtering to allow 1200Hz and 2200Hz to pass through.

### Blocking the HART Signal

There are a couple of reasons why you may not want to pass the HART signal to the isolator output. For one, you might have an older receiving device with insufficient noise rejection on its inputs, and the HART signal causes interference with the analog measurement. Another reason might be that you have a process signal that has to

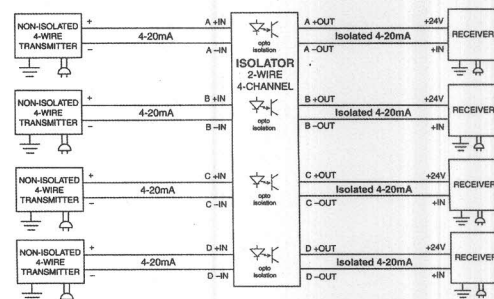


Figure 16. Multi-channel signal isolators and converters substantially reduce hardware and installation cost per point.

go to a DCS and also to a PLC and you do not want the instrument technicians reconfiguring the field transmitter. Furthermore, blocking the HART signal makes it impossible for a technician to make unauthorized changes to the HART transmitter using a hand-held communicator or from a HART-based control system. An isolator with good common mode rejection is generally all you need to block the HART from the output loop.

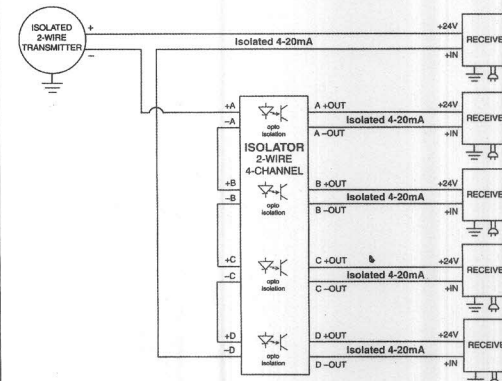


Figure 17. Multi-channel signal isolators can be used as a "splitter" to send one signal to multiple receiving devices.

### Multi-Channel Instruments Save Costs

Multi-channel signal isolators/converters combine multiple analog signal channels into a single instrument to substantially save panel space and instrument costs (Figure 16).

Multi-channel instruments can be used in most all of the applications of traditional signal isolators and converters at a very low cost per point. This would include taking one signal and, in the case of a 4-channel unit, split one signal into four, and send it to four different receivers (Figure 17).

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